Decision-Support Systems designed for Critical Care

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BACKGROUND

The multi-disciplinary group focussed on the use of various artificial intelligence approaches, initially as independent systems, but with the ultimate goal to integrate them into one main system (1, 2). Each approach provides different and complementary information in estimating a variety of patient outcomes.

METHODOLOGY

The case-based reasoner (CBR) provides detailed information about past patient cases that closely match several key attributes of the newest patient admitted, using a database containing 98 fields of clinical and administrative information for over 2000 intensive care unit (ICU) records. It uses a modified Rete match algorithm to develop a match score based on string, word, character, or number. The matching methods and weights were selected by the physician to determine the default values. They can also be fine-tuned for any of the matching fields to a patient's specific characteristics. The tool uses a friendly graphical interface and issues warnings, especially where a high match-score is made with a patient who died.

To estimate medical outcomes for an individual patient, a backpropagation, feedforward artificial neural network (ANN) has been trained and tested on a subset of the ICU database (1322 patients, two-thirds of which were used for training the network, and the remaining to test its performance), to estimate: "duration of artificial ventilation", "length of stay", and "mortality". To improve the results and eliminate problems of over-fitting, weight-elimination was implemented and results compared with ANNs not using this feature (3).

RESULTS

The CBR was assessed for a three-week period in a clinical setting. This led to a new version (2.2) which will include a faster matching engine and has been customised for two other hospitals where clinical evaluations are planned. Some questions to examine are: Is the tool helpful as an 'instant memory' of past similar cases? Does it change the diagnosis that would have been made without it? Does it help to explain the prognosis to the family? Does it help in choice of management and treatment of the patients?

In the ANN work, weight-elimination improved both the generalisation and the performance of a network trained to estimate the outcome "postoperative ventilation", a binary variable which classifies whether a patient's ventilation was less than or equal to 8 hours, or greater than 8 hours. The correct classification rate was just above 91 percent. This approach was also combined with a second technique, presenting 'high' and 'low' values of medical parameters to a pair of input nodes. Results facilitated the independent interpretation of the impact of the values of each input parameter in assessing outcomes.

FUTURE WORK

Future work will concentrate on applying the tools in a neonatal clinical setting (NICU) and for other medical environments such as rheumatoid arthritis populations. The ANN experience will be enlarged in several ways, using more output classes and different populations. - Finally, integrating these tools will provide a more complete assessment of patient outcomes.

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